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Hawaiian

Goffee

Planters'

Manual.

Price 50 Cents.

THE HAWAIIAN

COFFEE PLANTERS' MANUAL.

With Notes of the Methods of Coffee Culture
practised in Guatemala, Brazil,
Liberia and Ceylon.



EDITED BY H. M. ^{Henry J. Jones} WHITNEY.

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PREFACE.

THIS little manual has been prepared in response to numerous inquiries for information regarding coffee cultivation in these islands. Many excellent books on coffee have been published abroad which give a full history of its cultivation from the earliest period when its virtue as a beverage became known; but these, although valuable in a planter's library, do not supply the information specially sought for here. Most of this has to be obtained by personal application and experience. The object of this pamphlet is to briefly lay before the inquirer the methods of cultivation practiced here and in other lands, and to serve as a guide—experience and practice doing the rest.

But planters should bear in mind that in coffee planting, as much or more than in cane planting, thorough and careful work from the start is the only sure road to success. No matter whether it be five or fifty acres planted each year, the best preparation of the soil, the best seed, and the best plants, planted in the best way, will, if properly cultivated and cared for, repay the most profit in the end, and become a perpetual source of income, not only to the pioneer but to his successors.

Lands suitable for coffee are located on each of the five islands of this group, but it is difficult to purchase those that may be deemed the best located, owing to their being under lease. The Government is bringing suitable coffee lands into service, as the terms of lease expire, and occasionally sales in fee simple are made at public auction or otherwise. More of these lands will be opened to settlers in the near future, as special efforts are being made to this end. It is also probable that the public roads around the island of Hawaii, the lack of which is a source of great annoyance to settlers, will soon be improved.

It may be added here for the encouragement of those engaging in this industry that, by a law enacted Dec. 2, 1892, all coffee and ramie produced in this country, and all mills, machinery, appliances, tools, and buildings used exclusively in the care, cultivation, or preparation of coffee or ramie for market are exempted from all taxes and import duties for the term of ten years.

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HAWAIIAN

Coffee Planter's Manual.

Coffee has grown on each of the Hawaiian Islands for the past sixty or seventy years, and wherever planted and well cared for, it has generally yielded abundantly. On Oahu, Mr. Manini had a grove of trees at the head of Pauoa valley, and Chinamen also had another grove at the head of Manoa valley. On Kauai, several foreigners—including Messrs. Rhodes, Titcomb and Wundenberg—located at Hanalei, and made preparations to establish large plantations at Hanalei, which appeared to be a most favorable locality for the business. The trees grew finely and during the cropping season their plantations afforded as handsome a sight, with their bright green leaves, white flowers, and red berries, as was ever witnessed in any coffee country. But the blight came and invaded the valley, killed the trees and compelled those engaged in the enterprise to abandon it, and seek some other venture. And yet coffee trees may be found to-day, in many of the vallies of that island, bearing abundant crops. Had as much been known then about the antidotes to the blight as is now known, possibly these early efforts might have proved more successful.

The same experience with the blight was encountered in Kona, Hawaii, some years later, which discouraged those interested in coffee cultivation, but owing to the higher elevation of the lands there cultivated, many of the trees escaped permanent injury, and have continued to bear irregularly, and in some places to yield better crops than in others. Several years ago, there were a number of large trees on the premises of the Catholic mission at Hilea, Kau, which bore abundantly, and were rarely without berries. In size the trees were over thirty feet high, and always appeared healthy

and thrifty, indicating that some localities are better suited than others for their cultivation.

As much attention is now being paid to coffee culture, and many inquiries are made respecting locations and methods for starting in this branch of industry, the following pages have been compiled to furnish information to such as have had no experience in this business. In minor details, probably no two planters will agree exactly regarding the best course to pursue; but it is clear that with a full knowledge of the latest and best methods practiced in coffee countries, any person engaging in this pursuit cannot fail to meet with success, if he uses ordinary judgment in carrying out the details. It must not be forgotten, however, that the coffee tree requires four years of care and culture, to bring it to the bearing age, when the crops will annually increase, in proportion to the care which has been bestowed on them; and during this four years' term the planter should have some means of supporting himself and his enterprise, without embarrassment. And it is well to remember at the start that a small farm well tilled will be more profitable than a large one poorly kept.

Suitable land is not always obtainable by purchase, nor even by lease on a long term; but if secured in the latter way, in some cases it can be purchased before the term of lease expires, and such privilege should always be provided for, when possible. Some government lands now leased, can no doubt be purchased by the holders, as it is the intention of the government to make such provision. After securing the land, the first work in the line of cultivation will be to start the young plants, and just here the planter should make sure that he follows the best experience—such as has been tried and proved successful in other countries. To this end the following pages are devoted:

NURSERIES.—For this purpose a patch of gently sloping virgin soil should be selected, warm and dry, but close to water, soft, and not richer than that to which the plants will be subsequently transferred. The seed beds may be somewhat shaded, but not so as to entirely exclude the sun, nor so that the shading tree gathers rain and sends it in streams upon the beds. The seed-bed is cleared of all but the largest

stumps, thoroughly dug to a depth of nine to twelve inches, and made very friable. The beds are slightly raised to promote drainage, and are divided by paths into narrow strips. A deep trench is cut above the bed in an oblique direction, to prevent damage by rain and wash.

The seeds are sown in rows six to nine inches apart and about two inches deep. The seeds are strewn about one inch apart, lightly covered with mould, and shaded; a cheap and efficient shading may be secured by laying branches across a light framework. Watering must be done in the morning, or toward sunset. A bushel of seeds should give 20,000 to 25,000 of good plants.

The nurseries proper are prepared much in the same way, but not shaded. When the plants have two to four leaves (exclusive of the seed leaves) they are carefully loosened, and transplanted, in damp, cloudy weather, from the seed-beds to the nurseries, and placed ten to twelve inches apart. Care must be taken not to double up the tap-root, and not to leave a space for water to accumulate and rot the roots. If the tap-root is very long, it is best shortened by an oblique cut, and it soon shoots again.

When transplanting from seed-beds to nurseries is not practiced, the plants are left in the seed-beds until larger; but the best authorities strongly recommend the former plan, as, by checking the growth, the young wood becomes hardened, and better able, when finally planted out, to resist insects and unfavorable weather.

A practical suggestion for preventing young seedlings being eaten off at the surface of the ground by grubs, is to lightly wrap around a piece of paper about three inches broad, where the stem joins the root, on planting. In about a year the plants are ready for transfer to the permanent estate, which is meantime being prepared for their reception.

It is remarked by Hull that in Ceylon, abundant supplies of coffee plants of all sizes are generally to be found growing wild in the forests. These plants having grown up in the shade, are generally lanky and straggling, and consequently require, before being planted out on the estate, to be "stumped," i.e., cut down within six inches above the roots. These stumps are then very independent, and usually come on well, throw-

ing out shoots within three or four weeks from the time they are put in the ground. The best size of stumps is the thickness of a common pencil, these throw out shoots and take root more quickly than larger plants, while those that are younger and thinner are more liable to be burnt up by the sun, should the season be more than usually dry. When plants can be obtainable in this way, a nursery is but little required; but in case the planter should not be so fortunate as to find his wants thus supplied, it will be advisable to begin making a nursery at once. The best time of the year for this is when you can get fresh coffee seeds from the new crop.

A bushel contains about 25,000 berries of cherry coffee, and as most berries contain two beans, the number of seeds will not be far from 50,000; but allowing 50 per cent. for peaberries and imperfect beans, about 25,000 plants should be obtained in the nursery from one bushel of parchment.

Seeds should be selected as far as possible from healthy trees only, and should not be picked until fully ripe. The seeds are better not washed, but may be shaken up with wood ashes to dissolve the saccharine pulp adhering to them, and thus prevent fermentation. They should then be slightly dried, when they will be ready for the nursery.

The seed-beds should be dug up to the depth of a foot, all roots and stones being picked out. The surface must be nicely smoothed over, when the beans may be placed in straight drills and at equal distances from each other, being then slightly covered with fine mould. Over this a layer of rotten leaves may be spread two inches thick, the bed being then well watered at least one every three days, if the weather is dry. In about six weeks the seeds will begin to force their way above the ground and to send a root downwards, and the layer of decayed leaves may then be gently and carefully removed.

Where the nursery is made in virgin soil, manure will be unnecessary, and indeed is better dispensed with, as being calculated to introduce grubs likely to prey upon the seeds; but in old nurseries, after the first year or two, manure will be required.

The seeds may be put in about one inch apart at first, the plants being afterwards, as they increase in size, thinned out. The beds should not be more than three and one-half or four

feet wide, so that a person standing on either side may be able easily to reach the centre, without stepping off the foot path. Weeds can thus be easily pulled out, and the beds watered without any mischief being done. They may be either raised above the level of the surrounding paths, or the reverse, each method having its advantages in different localities. In damp situations the beds should be raised for dryness, while in very hot localities they should be depressed in order that they may retain, as much as possible, of the moisture they receive. Some planters prefer beds made perfectly level and surrounded by raised borders or "bunds" to admit of their being irrigated at pleasure. The drawbacks to this method, however, are, that the rush of water when it is let in carries the seeds in a heap before it, and also that the water after subsiding is apt to leave the ground hard and stiff. When once the plants have taken root and are well above ground, irrigation is the cheapest and most expeditious method of supplying them with moisture, and is not so objectionable except where the soil is inclined to be stiff and clayey.

If the plants are intended to stay in the nursery for a second or third season, they should be allowed space, and be at least three or four inches apart. If grown in straight rows at right angles, it will always be easy to ascertain the number of plants in each bed by measurement. Thus a bed three and one-half feet wide by twenty-eight feet long, with plants at four inches apart, would contain about 1200, or sufficient to cover an acre, planted at six feet by six feet.

The soil of the nursery is just as well *not to be too rich*, otherwise the plants will be apt to suffer from the change if put out into one of poorer quality. Some planters are strongly of opinion that the seedlings should be brought up in the same soil as that in which they are afterwards to dwell, and that, consequently, plants brought from a distance are less promising than those raised on the spot.

PLANTING.—When the holes have been duly prepared, the young plants are removed from the nurseries with the same care as they were transplanted to the nurseries from the seed-beds. For taking up the plants, an ordinary prong is much superior to the spade-bar; handpulling must be rigidly guarded against. The fibrous roots of each plant, as taken up, are

carefully pruned off to about four inches, so that they may not be doubled up in the planting; the tap-root is also shortened to about nine inches by a deep sloping cut, for the same reason. A ball of earth should surround the roots, and if the plants are to be exposed to the air for more than a few minutes, the roots should be covered with wet moss or some other damp material.

A dull cloudy sky should be chosen whenever possible; in bright sunshine the plants would all be burnt up. The plants are carried in batches on trays to the estate. They are placed in the ready prepared holes by hand, great care being taken that no roots are doubled up, that the plants are upright, and that they are no deeper in the ground than they were before. In treading the earth round the plant, every precaution is necessary to prevent leaving holes for the accumulation of water round the roots. The surface should be made firm and as level as possible. On a steep slope, the outer edge may be made slightly higher than the inner to check the effect of wash; but in subsequent weeding, it will be necessary to guard against exposing the lateral roots.

There is some diversity of opinion as to the size and age most suitable for putting out nursery plants. When dull rainy weather can be depended on for some little time, nursery plants of the second year are the most satisfactory. Plants of one season only are too tender for the operation. Under ordinary conditions, and with due care, no serious loss of plants should be incurred in this way.

A novel plan, which may be advantageously adopted in small plantations, is one resembling the method of planting cinchona. A number of calabashes are deprived of their small end and emptied of their contents; into these the seedlings are placed, gradually exposed to the sun as they grow, and finally planted in the calabashes; the latter soon rot and form manure for the plants.

A plan that has been much followed, is the substitution of "stumps" for nursery plants. Plants that have been in the nursery for about three years are dug up and pruned back, leaving only about six to eight inches of stem. They are hardier and safer, in a general way, than whole plants, more especially in uncertain weather. They will strike readily,

even without rainfall for some little time after being put in, provided the ground has become sufficiently moist to prevent their being burnt up; but they can not be used with success in districts where a long period of drought may be expected to succeed the wet season. The planting is performed in the usual way. The plants send up several shoots from the parent stem; of these the finest is retained to form the future tree, and the rest are pulled off carefully. The shoot that is left grows rapidly, but from the way it springs from the stem it is liable to be accidentally broken off, either by a high wind or by the weeder. The crookedness of the stems of stumps from native grown seed renders them very inferior; the best size for stumps is the thickness of a common pencil.

DIBBLING.—Where the land is very rich and friable, holing may be replaced by the less expensive plan called “dibbling.” It is performed in two ways:—1. By the aid of the spade-bar is made a sufficiently deep hole, into which the plant is dropped, and secured by treading the earth lightly around. 2. A patch of ground measuring about one foot each way is thoroughly loosened, without the soil being taken away; in the disturbed earth a hole is made with the hand, the plant is inserted and trodden around as before. The latter method is preferred. Dibbling is only practicable in exceptional cases. It is, moreover, open to objection, as a hole is often left, in which water accumulates and rots the plant, and the roots are more liable to injury than in ordinary planting. On the other hand, very much labor is saved.

STAKING.—When the plants are exposed to wind, they should be provided with supports as soon as they are ten or twelve inches high, and present a resisting surface. In moderately sheltered situations, staking combined with their low topping ought to be sufficient to secure the stability of the plant; where they are not, the situation has little to recommend it for coffee culture.

SHADE.—This is a consideration of great importance, and the opinion now generally adopted is, that the wholesale felling of the forest, in some places, has been altogether a mistake, and plantations which are now extinct might still be flourishing, had the forest shade been, at least, partially retained.

The history of coffee cultivation in the East proves that, in hot climates, and where prolonged seasons of drought may recur, coffee will not flourish permanently, except under shade. In a state of nature, the plant almost universally affects shade; this is the more remarkable that the seeds are deposited by wild animals and birds as freely on open grass lands as in forests. A suspicion that the borer, leaf-disease, and other immediate causes of decay, are only induced by the weakened state of the shrubs, consequent upon their exposure to lengthened periods of drought, is supported by the fact that where shade trees are found standing upon an abandoned estate, they are surrounded by a surviving remnant of coffee bushes.

The question as to where shade is necessary is one of climate; it is not universally beneficial. The advantages to be derived from it in very hot climates, are: Diminished exhaustion, and consequently increased longevity of the plant; reduced cost of cultivation; a conservation of the nutritious properties of the soil, and an actual increase of them, as the cover given to the ground causes the surface vegetable matter to decay more rapidly; and, provided the shade-furnishing tree be a subsoil feeder, the shedding of its leaves will yield a positive gain of surface matter, which the roots of the coffee tree would otherwise never have reached. The only drawback to shade would seem to be a diminished yield of coffee; but this is atoned for by the increased longevity of the plants.

PRUNING.—The kind of pruning first required by coffee bushes is that known as "topping." The age and height at which this operation is performed depend in a great measure, upon local circumstances; the question is also a much debated one. The object of topping or removing the top of the bush, is to restrain its upward growth within convenient limits, and, as a natural consequence, to strengthen and concentrate its lateral growth.

According to Sabonadiere, topping is commenced, in Ceylon, at the age of twelve to eighteen months, the maximum height being four feet, sometimes being reduced to two feet. He prefers to postpone the operation till the shrubs have borne the maiden crop, even though extra stak-

ing is required to withstand the wind. His plan is to remove the two primaries at the required height, by a sloping outward cut close to the stem, and then to remove the top by an oblique cut, so that the stumps resemble a cross, and a firm natural knot remains to guard against the stem splitting down.

Some planters contend that the plants should be topped as soon as they have reached the required height, when the soft wood is easily severed by a pinch between the finger and the thumb. In Natal, the shrubs are topped either at their full height four and half to five feet, or at three feet, allowing a sucker to grow up on the weather side to complete the height. The latter plan is preferred. There is much advantage gained in limiting the height to five feet; not only is the crop gathered more easily and without damage to the tree, but it is actually heavier, and the shrubs are more readily made to cover the ground.

The first result of topping is to induce the growth of a number of shoots, the removal of which is called "handling" or "searching." The first to appear are vertical suckers or "gormandisers" from under the primary boughs; these are immediately rubbed off without injuring the bark. From the primaries, spring secondary branches, in pairs, and at very short intervals. All such appearing within six inches of the of the main stem are removed at once, so that a passage of, at least, one foot is left in the centre of the tree, for the admission of air and sun. The object of pruning is to divert the energies of the tree from forming wood, and to concentrate them upon forming fruit. The fruit of the coffee tree is borne by young wood; and as the secondaries are reproduced when removed, they are cut off as soon as they have borne, and a constant succession of young wood is thus secured. In order that this may be regular, and to avoid weakening the shrub, the secondaries that grow outside of the foot space are left on alternate sides of the primaries, their opposites being removed each year in turn; thus one is growing while the other is bearing.

The one point in view must be the equal development of the tree, and the yearly growth of as much as it will bear, but no more. Branches must not be allowed to grow into or

cross each other; if two or more secondaries spring from one spot, the strongest only must be retained; where a gap occurs, tertiaries may be trained to fill it, in the same way. When practical, the bushes should be "handled" twice before the crop; and the pruning should be commenced immediately after the crop and finished before the blossom comes out. Should that be impossible, it must be suspended during the three or four days of blossom time, and then be carried to completion. When it is evident that the crop of a tree will exhaust it if allowed to mature, a portion of it must be sacrificed by pruning. The loss thus occasioned is more apparent than real. In very prolific seasons, much fruit is wasted for lack of labor, and the trees are unnecessarily overtaxed, and bear poorly for sometime afterwards. Everything should be done to ensure regular and even crops before removal.

Regular and systematic pruning is one of the first essentials to successful coffee culture; where plantations have been neglected on this score, they must be very gradually reduced to proper condition, by sawing out the cross branches, and opening up the centre of the trees, in the first year, and thinning out half the remaining wood, in the second year.

HARVESTING.—The clusters of buds which duly make their appearance are, at first, little dark green spikes, as they grow they become straw-colored, then under the influence of a few showers, almost white, and finally burst into snowy blossoms. After a day or two the flowers turn brown and fade away, the more gradually, the better. While the bloom is out, rainfall is unwelcome; but after it has "set," a shower is beneficial. The pistils of the flowers soon assume the form of berries, gradually growing and changing their color from dark-green to light-yellow, which finally deepens to red. As soon as a sprinkling of red berries is seen, picking should begin; it will continue as long as any berries ripen, say two to three months. The berries, or rather cherries, must not be picked until fully ripe, as indicated by a deep purplish-crimson color.

As the crop rarely or never ripens all at once, two or three pickings are required, the second being the principal one, while the others are rather gleanings. Each mature cherry

should be picked separately off its stalk, and never stripped off; the cherries as picked are dropped into a small bag, say eighteen inches square, suspended from the neck; these bags are emptied into two and a half or two bushels sacks placed at intervals, on the paths.

If allowed to get overripe, in wet weather the cherries are liable to burst and drop the beans, or to fall off bodily; on clean ground, much may be recovered. In hot weather, the cherries are more likely to dry up and hold on to the trees. In order to convey the cherries to the curing house, a great saving is effected, in long distances, by running them with water down galvanized iron spouting, made in eight feet lengths, laid with even gradients and curves, and duly secured. The cherries are dispatched from cisterns, to which the due proportion of water is admitted; provision is made for collecting and utilizing the latter at the works.

As it may be instructive and of interest to the readers of this pamphlet to know how coffee trees are cultivated in other countries, the following extracts are inserted, having been culled from recent reports of American consuls resident in Mexico, Guatamala, Brazil and other countries:

COFFEE CULTURE IN MEXICO.

In regard to coffee raising in Mexico, Maj. J. D. Warner, of the city of Mexico, says, in the *Mexican Trader*, under recent date :

Coffee raising in Mexico is yet in its infancy, but it pays from 100 to 200 per cent. on the capital invested, the Mexican coffee being of a superior quality and ranking among the best in the world. Coffee is worth at present, at the plantation, 20 cents per pound, while the annual cost of production averages only 7 cents per pound, the coffee being sold for cash only, and never commissioned out to find a market. Good coffee land with an exceptional title can be bought for from \$5 to \$100 an acre, according to location and condition, and an acre will grow 600 to 1000 trees.

He states that the coffee plantations of Mexico are never attacked by any disease or parasite; but in a document published by the Department of Industry and Commerce of that country, in 1883, among other insects injurious to the coffee

plant, one, the *gallina ciega*, is mentioned as attacking the roots and doing much damage to the plant.

The altitude recommended for the establishment of plantations is from 1000 to 3000 feet above the level of the sea, and such localities are the healthiest to be found in the tropics, being above the level where yellow fever and malarious diseases usually prevail.

The gathering of the crop is largely done by women and children, and labor is not difficult to obtain. Major Warner states that the average of wages paid in the coffee raising districts is $43\frac{3}{4}$ cents per day.

Senor Romero, Minister of Mexico in the United States, in a work on coffee culture published in 1875, estimates the cost of each coffee tree, four years from planting, at about 11 cents, including price of land and wages; that the tree in its fourth year will yield two pounds of coffee, which, at a minimum price of 10 cents, makes 20 cents per tree. The expense of gathering and preparation for market he puts at 5 cents, thus leaving a net profit of 15 cents per tree. With 1000 trees per acre, the net profit per acre is seen to be \$150 for the fourth year. The yield increases, ordinarily, to the seventh or eighth year.

The following remarks and directions in relation to coffee planting in Mexico are taken in substance from the government publication referred to above, and may, with some unimportant modifications, be applied to the cultivation of coffee in all countries that produce it:

CULTIVATION IN MEXICO.—The soil most generally suited for coffee plantations is a friable, sandy, or even gravelly, though the presence of clay in considerable amount is not objectionable, when the drainage is good; but soils that retain standing water, or those formed chiefly of alluvium, while they produce vigorous trees, do not yield coffee of good quality. The best soils are sufficiently deep to allow the roots to penetrate vertically to a distance of three feet or more, and should not rest on a substratum of solid rock or impermeable clay, as the moisture would be too long retained, and the plants injured. For this reason it is always advisable, in selecting ground for a coffee plantation, to make sure that the above conditions, as nearly as possible, exist; otherwise disappointment and failure may result.

It must not be supposed, however, that moisture is not necessary for the healthy growth and production of plant and fruit; for unless there is abundant moisture afforded by nature, in the way of rains and dews, artificial irrigation will be needed. The essential thing is that the moisture pass freely through the soil and not be retained standing about the roots of the plant.

The best plantations are made on virgin soil, from which a forest growth has been removed by cutting the trees and burning the branches and undergrowth on the ground, as the ashes are an excellent fertilizer, whose properties are lasting. Hill-sides are usually selected to secure better drainage, and eastern exposures are preferred, though not essential to the growth of productive plantations. Next to eastern, the western slopes are preferable, as on either of these the growing plants are not exposed all day to the direct rays of the sun, as is the case with northern and southern exposures.

Many planters are of the opinion that burning over the ground injures it, and no doubt this is the case if the whole forest growth be burned, as is sometimes done, but when only the branches of the fallen trees and the undergrowth are consumed by the fire, the general opinion is that the ashes are valuable as a fertilizer for the coffee plants. In Brazil, the fallen trunks of such trees as make valuable timber are sawed by hand by gangs of men, who go about the country for that purpose, since saw-mills are scarce, and the transportation of the heavy hard-wood logs would be almost impossible. Some of these woods are almost as hard as iron, and the sawing is difficult and very slow.

The plants for the future plantation are raised either on the spot where they are to grow, or in seed-beds, to be afterwards transplanted to their permanent place. The latter mode is that most generally preferred, as by it plants without defect may be selected, and of uniform size, which is not possible under the former system.

If the former method be chosen, however, the ground, cleaned of all growth, is staked off in lines, in which the seeds are planted, a few to each hill, at from six to eight feet apart. The rows are not so far apart as the hills, for these are arranged in the quincunx order—that is, three hills form the vertices of an equilateral triangle, two of them being in

one line and the third, or vertex of the triangle, being in the next line. This arrangement gives each plant the same root area as to every other one, and in situations when the plough can be used, allows cultivation in three directions. Of course the soil where the seeds are deposited must be thoroughly and deeply stirred. This is done by long, sharp spades, made especially for the purpose, and the holes are dug some two feet square and to about the same depth, in order that the roots may easily penetrate the soil in all directions. The earth removed from the hole is so replaced that what was at the top shall be at the bottom.

As the young plants need to be protected from the burning rays of the sun, banana plants, which are of very rapid growth, are set at the centers of the triangular spaces; or, as the banana propagates so rapidly and is so difficult to extirpate, when the coffee plants require the whole ground, many prefer to plant the wild fig, or some other plant easier to eradicate. In Brazil it is usual to plant a kind of tall coarse pea, called *quando*, which shades the ground effectually, prevents the soil from washing away, and is allowed to fall and decay on the ground. This plant is selected because it is rich in potash and affords excellent manure for the growing coffee plants.

As the ground rarely admits of cultivation with the plow, the soil is kept free from weeds by the use of heavy, sharp hoes, and the bushes that spring up are cut down with mattocks or grubbers, all the work being done by hand. During the first season, particularly, it is important that all weeds and grass be destroyed before going to seed, thus preventing new generations from appearing in subsequent years to increase the labor of cultivation. The burning of the bush on the ground, in the preparation of the future plantation, destroys many seeds that would otherwise produce weeds.

After the seed is planted, if no rain falls, irrigation will be necessary to prevent the earth about the germinating seed from drying, as in that stage moisture is necessary to the life of the embryo plant. Care should be taken that the irrigation be not excessive, as too much water is as injurious as too little. After the roots have formed and penetrated deep into the soil, the plant resists drought more easily. Of course, if several seeds germinate, the most vigorous plant is pre-

served and the rest removed, after a short time, or before the roots of various plants have become mingled together, so that in removing the others the roots of the one selected to remain shall not be disturbed.

The propagation of the plants in seed beds, which, as has been said, is the course usually pursued, is as follows: A spot of ground of the same quality as that of the proposed plantation is selected; since, if the seed bed be more fertile than the soil of the plantation, the young plants will start off with a vigorous growth, which will be injuriously checked by transplanting to a soil less rich. At the same time, the seed bed should not be lacking in the elements of vigorous growth, as puny plants rarely become vigorous, even when removed to a very fertile soil. Very much, then, depends on a proper relation of fertility between the soil of seed bed and that of the permanent plantation.

The location of the bed should be such that it will receive the rays of the sun during the forenoon, and remain in comparative shade after midday. The seed bed is thoroughly prepared by stirring and inverting the soil, and the seeds may be planted in ridges or in boxes set in the ground, having not less than ten inches of earth. Seeds that are perfectly sound and regular in shape and size should be selected and planted about two and a half inches apart. They should be covered with vegetable mold to the depth of about three-fourths of an inch, and the whole seed bed well sprinkled from a watering pot immediately after the planting.

All grass and weeds must be carefully removed from the bed as they appear, and the earth watered whenever it appears dry, which is best done late in the afternoon. Frequent light sprinklings, which keep the soil in an even condition of moisture, are preferable to profuse watering at long intervals, which makes the earth alternately too wet and too dry.

The young plants begin to appear in about a month, and in ten or twelve months are ready for transplanting, being, at that age, from twelve to sixteen inches high. The banana or other plants intended to shade the young coffee trees should be set out before the transplanting of the latter, and given time to become large enough to furnish shade from the first. The cultivation of the new plantation will consist

in keeping down the weeds and grass, and if these should grow to considerable size it is better to cut them down, allow them to dry, and burn them in piles, than to cover them with earth. Many insects and their eggs, or larvæ, are destroyed by the burning, that would not be killed by burying them.

The transplanting is done when the ground is moist from recent rains, and if a ball of earth be taken up with the roots of the young plant, it will start off more quickly and vigorously in its new place. If the plants destined to furnish shade have not been previously planted, it will be necessary to stick a branch with leaves in the ground beside the young plant, so as to shade it until it takes new root; but these branches should not be left there longer than necessary, as they become the breeding place of insects which are injurious to the coffee plant.

If the roots of the plants are torn in removal, they should be cut obliquely and smoothly above the wound. The plants can be conveniently carried from the seed bed to the plantation in large baskets, whose bottoms are covered with moist earth. The direct rays of the sun should not be allowed to fall on the plants during their transportation and planting. The plants should be set at the same depth as in the seed bed, and the ground about them watered in the afternoon of the day of transplanting.

In addition to keeping the new plantation free from grass and weeds, the suckers or shoots which will push at the base of the plant should be removed, as well as all diseased branches and such as lie on the ground. Some of the plants will die, and these must be replaced by the most vigorous ones from the seed bed.

Some planters think it best to pinch off the terminal buds of the top boughs when the plants have reached a height of five or six feet. This is to prevent the tree from growing too high for the convenient gathering of the berries. Others believe that this process injures the quality of the coffee, an opinion apparently ill-founded, since the general practice is to top the trees, which makes them more stocky and the lateral branches stronger. In the forest, surrounded by other trees, the coffee tree grows tall and produces but little.

A Mexican authority declares that the coffee tree will not bear pruning, but in Brazil and other countries it is freely practiced. The distance of the plants from each other varies considerably in different countries and localities. In Costa Rica it is recommended to give them a distance of ten feet. In Brazil, from ten to twelve feet is the usual distance, while in Mexico six, seven or eight feet seems to be preferred. No doubt the size of the tree at maturity is that which determines the proper distance under the system of pruning that is practiced. A distance of ten feet in the quincunx order of planting will give about 500 trees to the acre.

Generally, if the soil of the plantation is originally of sufficient fertility, little or no manures will be required, if the leaves that fall annually from the trees, and vegetable growth that is raised between the rows are turned under the soil to decay; but where manures are necessary or desirable, the vegetable should be preferred to the animal. Ashes are an excellent application, as the coffee plant is a consumer of potash.

If the ground of the plantation is very steep and the soil inclined to be washed away, it is better not to keep it too clean of grass and weeds, as these retain the earth by their roots and stems that lie on the ground; and sometimes diagonal ditches must be made to carry off the excess of water more slowly than it would descend the slope if unobstructed.

Although there are few plants less exposed to the attacks of insects and disease, the coffee has certain enemies, both animal and fungus, which require attention, but none of these present great difficulties in overcoming. A growth of moss is probably indicative of too much moisture and a generally feeble condition. Very few specific remedies are employed against insects, which are rarely very formidable.

The trees begin to produce in the fourth year, and in the seventh reach their full capacity. A coffee plantation favorably located and properly cared for will continue in profitable bearing some forty years.

Mexican coffee is considered to be milder and, in some respects, superior to the product of some of the other coffee producing countries.

COFFEE IN GUATEMALA.—The production of coffee in Guatemala is steadily, though not rapidly, increasing. In 1887, the production was 48,539,267 pounds, and in 1891 the exports of coffee reached 293,274,971 pounds.

The temperature best suited to the healthy growth and abundant production of the plant in Guatemala is between 60 and 90 degrees Fahrenheit, the former being rather too cool and the latter too warm for the best results. In the lands whose altitude from 1500 to 2000 feet, and where the ruling temperature approaches the latter limit, the young plants must be shaded, in new plantations, by tall and rapidly growing plants, otherwise their growth is unhealthy, as is betrayed by the small size and yellowish appearance of the leaves.

For the purpose of shading the young trees, the banana is very generally employed; as it not only affords abundant shade, but produces paying crops of its own. After one or two seasons' growth, the coffee plants need no further extraneous shade.

In districts whose mean elevation is 4500 feet, plantations must be sheltered from the cold north winds, which, during December, January and February, blow almost continuously, and destroy plantations exposed to their full force. A range of hills to the north of and overlooking the plantation is the best natural protection that can be found, but in the absence of this, it is customary, when the mercury at night falls to 60 degrees, to burn heaps of rubbish mixed with pitch on the north side of the plantation, and the dense smoke, drifting over and through the rows of trees, furnishes complete protection from the effects of the cold.

The scarcity of labor has been, and continues to be, the main obstacle to a rapid increase in the coffee product in the extensive lands of Guatemala so well suited to the growth of the plant.

The manner of raising the plants and setting them in the permanent plantations is almost the same as Mexico, and the same cultivation is given to the growing trees. The critical season for the future crop is the blooming period. A heavy rainfall, while the trees are in flower, will seriously damage the plants, washing away the pollen and thus preventing

fructification. This period lasts three or four days, when the blossoms fall and the "cherry," as it is called, begins to appear. The "cherry" reaches maturity in October and is ready for gathering and "pulping"—that is, for the removal of the outer shell and pulp, after which it is washed and carried to dry, spread out in brick-paved yards exposed to the sun.

The methods employed for the handling of the berries after gathering may be greatly improved, and when the modern machinery and drying apparatus, such as are used on the larger plantations in Brazil, shall have been introduced, the Guatemala product will be greatly improved, both in quality and amount. The profit, too, of the culture, in a country where labor is so scarce, must depend greatly on the employment of all means which will economize manual labor.

German settlers have taken up coffee lands to such an extent that it is estimated that fully one-fifth of the plantations are in their hands.

COFFEE IN BRAZIL.—In 1891, the exports of coffee from Rio de Janeiro alone were 425,055,000 lbs. valued \$42,500,000 at 10 cents per pound. The exports from Santos are usually about one-half of those from Rio, and from these two ports the bulk of the coffee sent abroad is exported. The magnitude of the coffee growing interests in Brazil, and its importance in maintaining the national wealth and credit, may be estimated when it is considered that the United States alone paid to Brazil for her coffee in 1891 more than \$45,000,000.

The profitable cultivation of coffee in Brazil is confined to the four states of Espiritu Santo, Minas-Geraes, Rio de Janeiro and Sao Paulo. It is produced as far north as Para and in considerable quantities in Ceara, but the yield is less and the quality inferior to that of the product of the famous zone comprised in the four states just mentioned. The growth of coffee culture has been natural and remarkably rapid. No favors from the government, such as have been given to sugar production, no inducements to immigration on the part of national or state governments have contri-

buted to the remarkable development of this great agricultural interest; but the natural adaptation of the soil and the growing demand for this staple have been sufficient to increase its exportation from thirteen bags in 1800 to the enormous quantities that annually load the vessels of all nations in the ports of Rio and Santos. The facilities for transportation from the interior to the coast have been a great factor in this increase, no doubt, as well as the moderate rates of freight on the railroads that have their termini in these ports.

The plantations are generally made on hillsides, from which the heavy forest growth has been cleared by felling the trees and burning off the undergrowth. The valuable logs are sometimes sawed on the spot into boards and planks; sometimes burned, after drying, and sometimes allowed to lie on the ground and decay. The latter method is perhaps the best, as the logs contain the wealth of the soil accumulated during years, which is thus returned to it again. As the cultivation is done altogether with hoe, spade and mattock, these decaying trunks are not so much in the way as might be supposed. All the vegetable growth that can be kept on the ground and does not interfere with the growing coffee trees aids in preventing the washing away of the mold from the soil, which a bare cultivation would carry off in a few years.

A plantation, properly managed, lasts for about thirty years in profitable bearing, and by that time the soil is worn out, as is attested by the many bald, red hills to be found in the older cultivated districts of the coffee zone.

The young plants are sometimes raised in seed beds, as described in speaking of coffee culture in Mexico: sometimes young shoots from the roots of old trees are employed, and sometimes the more expensive, but better, method is resorted to of raising each plant in a separate earthen pot, whence, at one year old, it is transplanted with all the earth about its roots to its permanent location. Long rows of these pots with their plants, set on a slope, over which water is constantly running, and protected from the hot rays of the sun by matting stretched on poles above them, may be seen on the plantations where the best methods are employed. The

system is costly, but about a year is gained in the growth of the trees, and the plants, receiving no check by transplanting, rarely need replacing. It has been found advantageous also to select the very best grains for seed, and some planters have succeeded in establishing improved and distinct varieties, by repeated reproduction from the same kinds of seed.

Nowhere in the world is greater attention given to the cultivation and handling of coffee than in Brazil, and nowhere else is improved machinery for the preparation of the crop for market so generally employed. It is the fashion in praising the coffee of other countries to describe it as superior to the Brazilian, but no permanent advantage is gained by unjust comparisons, for they are against the facts. The truth is that no coffee anywhere in the world is superior to the Brazilian, which is sold everywhere as Java, Mocha, Maracaibo, etc., at the fancy of the dealer and whim of the consumer. Every plantation in the country produces the Java and Mocha of the markets of the United States, and it is only an affair of sieves of differently sized meshes to classify the products of Brazilian plantations into the falsely named kinds, in order to demand a higher price from the buyer. These facts cannot be controverted any more than can the other truth that no country produces coffee superior to that of Brazil. The coffee with a small, round grain, called, generally, "pea-berry," and sold in the United States as "Mocha," is produced by topping and severely pruning the ordinary plant, although many such grains will always be found on trees treated in the usual manner.

While the young trees are growing, crops of corn or mandioca are sometimes raised between the rows, which are planted in the quincunx order, and these crops are sometimes sufficient to repay the expenses of the plantation. At the age of four years the trees are about six feet high and in profitable bearing. The principal gathering month is November, and then every available hand is engaged in picking the berries in baskets. The average result of a day's gathering for each person is enough to produce about fifty pounds of dried coffee. The baskets are emptied of their contents into carts which convey the berries to the mill-house, where they are to be prepared for market.

The berry resembles very closely the cranberry, and contains two grains with their flattened sides toward each other. Each of the two is covered with a closely adhering membrane called *pergaminho*, and outside of this is a thicker and more loosely fitting coat called *casquinho*. The two grains with their coverings are contained in a tough shell called *casco*, and this is surrounded by a white pulp and outer skin, thus forming the berry.

To prepare the coffee for market, all these coverings must be removed. The outer pulp is removed, after maceration in water, by a machine called *despolpador*, which consists of a revolving iron cylinder set with teeth and covered on one side by a concave sheet of metal.

A trough lined with cement is placed on a hillside above the mill, and through it a stream of water is kept running. Into this the coffee berries are thrown and are carried down by the stream into a large vat. In this vat the heavier berries sink to the bottom, whence they are drawn off through a pipe to the *despolpador*. This machine removes the pulp, the berries passing with the water to another vat beyond. In this the water is kept in constant motion by a revolving wheel, and the pulp is thus thoroughly washed off and carried away with water, while the coffee grains sink to the bottom; and thence passing to a strainer the water is all drained off, leaving them ready for the process of drying.

Two methods of drying are in use; the old process, which consists in spreading the grains on a cement-covered pavement called *terreiro*, where they are allowed to dry in the sun. For this about two months are necessary, and the grains have to be raked over and turned during the day and gathered into piles and covered at night. Whenever a shower comes up the coffee must also be covered. The more modern and satisfactory process of drying by steam is employed on many of the large plantations. By this process the drying, which by the old method requires about sixty days, is accomplished in a few hours, with a vast economy of labor. Under this system drying is done in large, shallow pans of zinc heated by steam coils beneath. This process will, doubtless, on large plantations, supersede the older and more expensive method. The drying is done more uniformly and with no danger of injury from sudden rain.

The coffee, after drying, is still inclosed in the inner and outer skins, which have been rendered more brittle by the drying. The machinery necessary for the removal of this is somewhat complicated and expensive. The most efficient of the machines in use are from the United States, and a complete plant for a large plantation will cost not less than \$25,000. The coffee is brought from the drying house and placed in bins, whence, by an elevator band, it is carried to a ventilator, where it is rid of rubbish and dust by sifting and fanning. From the ventilator the coffee is carried to the sheller (*descascador*), which consists of a toothed cylinder, by whose rapid revolutions the outer and inner husks are broken. The grains and broken husks are carried by a pipe to a second ventilator, where the latter are sifted out and fanned away, and the former are carried by an elevator to the separator. This is composed of hollow copper cylinders, pierced with holes of different shapes and sizes. These cylinders are kept constantly revolving, and the coffee grains, passing through the holes, fall into separate bins, being thus assorted according to their size and shape.

The coffee thus mechanically sorted and classified goes into the markets of the world, where it is sold, the small, round grains as Mocha, the large flat grains as Java, and so on, until all the coffee-producing countries are represented in all the corner groceries of the world by the product of a single Brazilian plantation.

[The following article is abridged from the Jamaica Botanical Bulletin, and conveys much information about the Liberian coffee tree, which for some localities, is thought to be superior to every other variety, for resisting insects and diseases.]

COFFEE IN LIBERIA.

Liberian Coffee is a native of Guinea, and is found on the low hills from near the sea-coast to considerable distances inland. The climate of the west coast of Africa is very damp and the rainfall heavy. This species grows naturally into a

tree, twenty to forty feet high, with a long tap root. The berries are much larger than those of ordinary coffee, and do not drop from the branches for a long time after they are ripe. They differ also in the pulp becoming very hard, when dry.

SOIL.—The soil should be deep, rich, and friable. Soil that is very shallow or altogether clayey, and situations where water is retained for any time, must be avoided for plantations. But a certain amount of clay mixed with stones or limestone debris is not prejudicial, if the drainage is perfect.

CLIMATE.—Although in Liberia this coffee grows with an excessive rainfall, said to be 187 inches, it is certain that such a large amount is not by any means necessary. It gives large crops at Castleton Gardens with a rainfall of 110 inches and a mean temperature of 76° F., at an elevation of 580 feet. Even at Hope Gardens with an average rainfall of 55 inches, it grows well, and produces a crop; and probably in situations as dry as the Liguanea plains, it would, if irrigated, bear heavily.

ELEVATION.—It is essentially a tropical plant, and probably would not succeed at higher elevations than 2,500 feet, but where ordinary coffee does well, there is no need to replace it by its rival. In any suitable places below the lower limit for ordinary coffee, it would repay cultivation.

PLANTING.—The seeds may be sown in a nursery in beds about 4 feet wide in good soil well dug and pulverised. They should be sown 3 or 4 inches apart, and afterwards transplanted into bamboo joints for convenience of carriage to the fields. They may also be sown in bamboo pots at first. The nursery should be shaded from the direct rays of the sun.

When the plants are put out in their permanent position, they will still require shade, and perhaps bananas are the most suitable plants for this purpose. It is possible that in dry situations, permanent shade trees will be found necessary, and perhaps the best are the gnango, the bread fruit, and jack fruit trees.

The distance apart for planting depends a good deal on the soil, and whether the tree is topped. It may vary from 8 to 12 feet.

TOPPING.—As to topping Liberian Coffee trees some planters do not top them, but allow them to grow up naturally. In

Liberia they are topped down to 5 feet, and planters there say that they obtain larger crops by this plan. When the trees grow up high, considerable injury may be done by careless pickers. It may be found that 5 feet is too low, and 8 feet for instance, a better height; but just as the practice of topping ordinary coffee varies throughout the island, it will be found necessary to experiment with Liberian Coffee and discover the best method for each district.

YIELD.—Extracts are given below from the *Kew Bulletin* showing that crops of 9 to 12 cwt. per acre can be obtained from trees after the third or fourth year.

PULPING.—The tough fibrous character of the pulp renders the ordinary coffee pulper quite unsuitable for use with Liberian Coffee, and for some time after attention had first been called to this new product by Sir Joseph Hooker from Kew, no satisfactory pulping machine was invented. Later, however, a machine has been devised by Messrs. John Gordon & Co., 9 New Broad St., London, E. C., which is the only special machine required for treating Liberian Coffee, as all the other machines treat Arabian and Liberian Coffee equally well.

Gordon's Improved Coffee Pulper has been specially designed for pulping Liberian Coffee. The working of the machine is simple, and no difficulty whatever will be found in obtaining good results, always provided that the coffee be ripe and freshly picked. The cost of the pulper is from £60 to £100.

They also make larger Pulpers, which are provided with a Separator for classifying the Cherry Coffee, each size thus obtained being delivered into a particular channel adjusted to that size. This arrangement greatly assists the perfect pulping of the berries, since the machine has practically to deal with berries of the same size.

A Separator also can be used in conjunction with two or more separate Pulpers, each Pulper adjusted to take one size of berry.

In Java the Liberian Coffee cherries are fermented before they are pulped.

Messrs. Gordon state in the *Kew Bulletin*:—

“We have supplied pulpers for Liberian Coffee to Java,

West Coast of Africa, and mostly to the Malay Peninsula. One firm there, Messrs. Hill & Rathbone, have had six or seven pulpers; they have also our peelers and separators.

"It is quite imperative that water be used in pulping, and where it is not obtainable the only course, we fear, is to dry the coffee in the cherry, when it can very well be peeled, only this takes some power.

"Our peelers and separators will treat Liberian equally as well as ordinary Arabian Coffee, and as far as these machines are concerned there is no difference of construction. It is only in the operation of pulping where difficulty has been found, necessitating a special pulper."

"They have also a machine for separating the pulp from the coffee after it has been discharged from the pulper.

"The machine is very simple and complete, and only requires to be fixed on two wooden beams over a tank containing water. The cylinder should be immersed in the water to the depth of about four inches.

"It is substantially constructed of very stout iron rods, securely fixed in wrought iron rings, as shewn; the hopper, bearing and mouth piece at the feed ends, being in one piece.

"The cylinder is also fitted with an internal worm or screw for propelling forward the pulp.

"It is made in five and ten feet, or any intermediate lengths, at proportionate prices, and can be supplied either thoroughly well painted, or galvanized.

"Smout's Patent Coffee Peeler and Polisher is an excellent and simple machine that has met with the greatest success, and its superiority is proved by the higher prices obtained for coffee which has been treated by it. It is now considered indispensable and is employed in all the large establishments for the cleaning of Coffee in London, Hamburg and European ports. There are no complicated parts with springs or other contrivances to get out of order, and owing to the strength of its construction no part is liable to breakage or to wear out.

"The working of this peeler is extremely simple. The machine having been put in motion, the parchment coffee is fed into the hopper, when it is only necessary to adjust the weight on the lever of the discharge door and the regulator on the Fan and the Coffee will be turned out with the desired

finish. If the machine is properly adjusted, the Coffee will only require to be passed once through it.

"This peeler possesses the advantage, that it can be worked equally well at any power up to its maximum, the quantity of Coffee cleaned being in proportion to the power applied. It works without noise and without creating dust and it is the only machine that does not break a single grain of coffee. We venture to say, that it is also the cheapest Peeler in the world, as no other machine at the same price can produce an equal amount of work.

"We can supply it either with or without the Exhaust Fan. By means of the Fan the Coffee is delivered quite clean and fit to be passed at once to the Separator. This arrangement is a very valuable improvement, as it saves not only the time occupied; but also the labor required to carry the coffee to a separate Fan for the purpose of removing the dust and chaff. The Exhaust Fan will be set to blow in the direction shown in the sketch, unless specially ordered to blow in the opposite direction.

"When more than one machine is required, two or more can be coupled together and driven by one band. This machine can be divided for mule carriage when desired."

The following account of an experiment in planting Liberian Coffee appeared in the Madras Mail of 10th May, 1890, and was republished in the Kew Bulletin for November, 1890:

Some 15 years ago I received a couple of Liberian plants from a number presented to a Planters' Association by Government. These had come out to the country, I believe, from Kew direct, in a Wardian case. Planted in a back garden and almost unnoticed and uncared for, they grew broad and high till now they are about 26 feet and have apparently no intention of stopping. In the evil report soon after prevailing regarding Liberian Coffee, I supposed there was nothing in it till at length I began to notice that the trees were bearing very well, and that there was no trace of leaf disease. Then I planted out 200 or 300 seedlings, in a new clearing along with Arabica, and these, now seven or eight years old and in a more sheltered position than their parents, have done even better. Planted 10 by 10 over Arabica they have

now ran up to 16 or 18 feet, all exactly of one type, and are bearing exceedingly well; the crop on them for this season cannot well be taken at less than three pounds of clean coffee per tree. The Arabica underneath them has suffered frightfully from fungus regularly every year, yet I challenge any one to find a sign of it on them. A few of the old leaves, turn yellow and tumble off, as was the natural way of our old staple before the days of leaf disease, as I well remember before 1868. We know that Liberian Coffee will grow at the sea-level; the ones above referred to are at 2,500 feet in sheltered bamboo land: whether they will do well at higher elevations remains to be seen, but as far as I can see I am satisfied, and only regret that I did not do eight years ago what I am doing now, viz., plant Liberian all over my clearing *with the Arabica* and let the best win. To sum up, the points of difference between Liberian and Arabica I find as advantages:

1. That it does not get fungus, or only in such a way that the health of the trees is in no way affected.

2. That it is a tree, not a bush, running up to 30 feet in height before fifteen years old, and in consequence is not injured by drought.

3. That judging by the trees in evidence, and the way they go on growing, and by the fact that they do not come into bearing till four or five years old, this variety may be taken as much longer lived.

4. That is a heavier bearing tree when once fairly started; those in evidence now yielding ten to twenty hundredweights per acre, calculating on the clean coffee yielded, and admitting that only some 700 trees to the acre can be grown instead of at least double that number of the old kind.

5. That being a deep-rooted plant, it is not affected by drought, while a very slight shower is quite sufficient to bring out and set the blossom; which moreover, has the further advantage of fading and falling off within the day of its opening, so that it is hardly possible that it can be injured by rain or hail as is so often the case with the delicate Arabica blossom. Even in the very driest season, when the other plants appear on the point of destruction, these look cool and green and not turning a leaf.

6. That the cost of cultivation is comparatively little. There is no pruning to do beyond pulling off the suckers for

two or three years to prevent the tree from running up into too many stems, the crop is carried on the same wood (and extensions of it) year after year, and there is, therefore, no old wood to cut out. The shade of a thick, tall tree like this, where they pretty well cover the ground would effectually prevent weeds from becoming troublesome, and as the roots are deep down, the debilitating effects of weeds even if they did grow, would be very little felt.

7. The berries (of the size of a walnut) remain firmly fixed on the tree for many weeks after they are ripe enough to pick; eventually they fall off, and may be gathered off the ground. In the case of scarcity of labor this might be an advantage.

Against these good points we may set the following:

1. That this species gives very little return till at least the fifth year, while in low-lying districts some return is got from Arabica in the second year.

2. That the value in the London market, from a sample lately sent home, is about 10 per cent. lower than that of ordinary coffee.

3. That in districts under the south-west monsoon, whose flowering season is in March and April, the crop instead of beginning to ripen in October and finishing in January or February take a whole 14 months to ripen. The flowering season is the same as the other, but though some berries will turn ripe in the following April much of it will not be ready to gather until July. Thus the tree carries two crops at the same time, and all mixed together on the same branches. Sometimes at the end of the spring we may see at the same time the crop of the previous season as large as plums, and partially turning red, the crop of the current season the size of peas, and a further sprinkling of the curious eight-petalled, heavily scented blossoms as large as the palm of a child's hand. All these mixed together among the large dark, glossy leaves, give the tree a most rich and handsome appearance.

There are now one or two points about which some information may be of interest.

Picking.—There is no difficulty about this: a notched bamboo enables the coolie to get up among the branches, and he

then picks off all that are ripe, or nearly so (taking care not to rip off the small berries), dropping it all on the ground, and collecting afterwards into baskets.

It takes four bushels of these huge cherries to make one of parchment (instead of two as with *Arabica*), but even so, the fruit being so large, a coolie can pick quite twice as much as of the other, and the cost per ton of clean would be much the same.

Curing.—I have seen advertisements of special pulpers made in Ceylon for Liberian coffee, and have no doubt that they are as effective as they are represented. Any one growing a quantity of this coffee would have to employ machinery.

I have tried experiments on a small scale with my cherry, and found that it was no use to pass the stuff through an ordinary disc pulper (set of course very wide), because the husk never (at this elevation) gets soft enough to squeeze out below the chop but rolls up into a hard ball and comes out with the parchment in front: and I found that when the chop was set wide enough to allow the husk to pass, the bean went with it. Moreover the work was so hard that four coolies were completely tired out in pulping two bushels. Then I found the simplest way of getting at the parchment was to put it up in heaps in the pulping house to rot. This may seem barbarous, but the color of the clean coffee so treated was quite as good as some treated in the ordinary way, indeed the parchment envelope of the bean is so thick and strong that it completely protects it from injury from heating. Moreover this kind of coffee will carry nothing but a dead whitey-green color no matter how the curing may be done. If allowed to dry in cherry some heavy peeler might perhaps break it up, but it seems to me as hard and tough as the very best road metal and I much doubt whether a coffee curing firm would undertake it on the usual terms. As regards the drinking qualities of this variety, I can safely say that no one who had not previously been told would know that he was not drinking the common article, the same quantity of powder goes further and I cannot notice any inferiority of quality. Unsuspecting guests have often said "May I have another cup of this excellent coffee?" and they usually look somewhat surprised when

told what it was. If you try to sell it in the bazaar whole and clean (looking something like date stones in shops) natives decline to buy it. "This one kind bad imitation coffee" they will say, but if you smash it up and mix a little dirt with it they will take it readily. and never find out the difference.

Planting.—Owing to the seedling throwing out a strong, deep, tap root, something like that of a jack tree, I am inclined to think that when a plantation has to be made it would be better to have the pits made ready by May, and then to put one or more seeds in each pit as early in the south-west monsoon as possible, so that the seedlings may get established before the end of the north-east monsoon in December. But if not grown to any great size they can be lifted with a little special care from nurseries in the ordinary way. Considering the fact that Liberian coffee does not come into bearing till two or three years after the other, it may probably be a wise plan for one going in for its cultivation to pit his clearing 4 by 4 and to plant Arabica, afterwards putting in the giant kind down every other row, making them thus 8 by 8. The Liberian is much too robust to take any notice of its little friend, while by the time it has come into bearing you may safely assume that the Arabica has given what it can in maiden crops, and unless heavily manured has already made arrangements for returning to a better world where there is no fungus.

The *Kew Bulletin* for November, 1892, contained the following giving actual figures of results obtained:

The more important plantations yielding regular crops of Liberian Coffee are established in Java and in the Straits Settlements. In the latter the yield per acre in full bearing is given as ranging from $9\frac{1}{2}$ cwts. to $11\frac{1}{2}$ cwts. per acre. Placing the price of Liberian coffee as low as 90s. per cwt., this would show a gross return of from £42 to £52 per acre. This is a higher return than is obtained from almost any plantations of Arabian coffee.

The returns from the Liberian coffee estates are interesting and show that under favorable circumstances the yield is not showing any tendency to decrease. Linsum and S'Lian in Sunge Ujong, estates are surrounded by forest, and the atmosphere is generally laden with moisture (rain fall from

90" to 120") and rain falling on over 200 days in the year, with heavier and more continuous rains in October, November, and the early part of December. The older fields on these estates are manured yearly, and weeds are allowed to grow and have been for many years for a large portion of the year. At certain times the estates are, for periods varying from six weeks to three months, kept scrupulously clean. The cost of cultivation is from \$70 to \$90 per acre per annum. The soil is not particularly rich, but the climate, from the moisture, makes the estate very productive. The export duty of thirty (dollars) cents per picul produces to the Government an equivalent of a quit-rent of \$2.40 per acre on the land in full bearing.

The younger fields on this estate are finer than the old coffee was at the same age, they all having been planted from selected seed from fine trees, thus getting a pedigree seed, some of the clearings being planted from the 4th generation of seed so selected, and the 5th generation of seed is now in the nursery.

The Liberian coffee-plant is, curiously enough, free from parasite attacks, possibly because, being more recently reclaimed from a state of nature, its constitution is less enfeebled than the old variety, which has been cultivated for at least a thousand years, though in Arabia it does not date further back than the early part of the fifteenth century. The Liberian plant has, in addition, the advantage of being very prolific in highly aromatic beans, and as it loves low lands, it can be grown at altitudes unsuitable for the Arabian coffee, the native country of which is the uplands of Abyssinia. But something more than climate is necessary to a profitable coffee plantation. It requires a well-watered mountain slope not much over 25 degrees from the equator, and between 1000 feet and 4000 feet above the sea, where the mean temperature is not less than 60 degrees. Then the soil must be friable and well drained, and enriched by the fresh loam which is being constantly washed down the hill-slope by the tropical rains. In Quito and Peru, no doubt, there are plantations at a height of 6000 feet on the Andes. But even at this elevation in such a climate frost is unknown. Moisture is especially necessary, and if the rainfall be deficient the ground must at intervals be carefully irrigated.

For at least three years after the seedlings are set out no return can be expected, while the labor of the cultivator in weeding, cleaning, pruning, draining and "handling" the plants generally has to be unremitting, if his hopes are not to be doomed to disappointment. In the third year the little shrubs begin to yield a remunerative crop. Yet, even at the best of times, the ordinary Arabian variety cannot be reckoned upon to bear more than from one and a half to two pounds of berries in a season, though much depends upon the climate, soil and situation. The Liberian species is said to sometimes bears as much as sixteen pounds of marketable beans during the eight months it continues to flower. Three gatherings are usually made every year, since the berries, owing to the circumstances mentioned, may at any period be of unequal ripeness. These operations naturally require great care, judgment and experience, for the value of coffee depends entirely upon its flavor, and such a seeming trifle as not cutting off the irrigating streams at the proper time will injure the aroma of the berries, while a deficiency in the water supply or the presence of weeds between the rows is equally apt to reduce their dimensions. The latter point is vital, for the shape, size and color of the beans are among the principal elements which determine the value of a crop, and are affected by very trivial circumstances. Then the shape seems related to the particular part of the plant upon which the berry grows, the size and succulence on the nature of the locality, while the color has, according to the investigations of Mr. Hiern, reference to the degree of maturity which the fruit has attained at the time of gathering. The nicety with which the beans are sun-dried and passed between rollers, in order to remove the external pulp and the membrane enclosing them, has also an influence on the esteem in which they are held.

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COFFEE CULTURE IN CEYLON.

SEED.—The selection of seed is a matter of great importance. If Coffee Arabica is to be grown, care must be taken that the seed is procured from healthy vigorous plants from seven to ten years old, and from those plants only which

have strong and sturdy branches and on which the bud-joints are close. The object being to get heavy crops, close bud-jointed branches are essential, as such mean a larger surface on which the cherries will develop. Good seed is procurable locally, both the Arabian and Liberian species. The seed should be fully ripe when gathered for planting; should be pulped by hand, unfermented, unwashed, dried in the shade, and be in the parchment. It should be perfectly fresh when planted; old seed is useless. One bushel of seed, as above described, will give about 25,000 plants, sufficient to plant about 37 acres eight feet by eight feet, if the Arabian variety be planted; and about 80 acres, planted twelve feet each way for Liberian.

THE NURSERY.—Prior to the arrival of the seed, it being a matter of utmost importance that the seed be planted as fresh as possible, it is advisable to set about getting a nursery ready. The nursery should be on a high, moderately sloping piece of land, in close proximity to water, because the seedlings will require watering daily. The soil should be the richest procurable, and should be thoroughly ploughed and pulverised to a depth of at least 18 inches. The land should now be laid off in beds, each running down the whole length of the slope, and three feet broad. The beds should be thrown up, and separated from each other by a wide furrow or path. At the top of the slope a drain should be dug to divert the surface water. A bit of flat land, provided it is high, can be used equally well for a nursery, but the beds will require to be thrown up well, and drainage provided all round, the beds being separated by drains and paths. A nursery half an acre in extent, allowing for paths, etc., will provide sufficient space to rear 85,000 plants, or sufficient for three bushels of seed, enough to plant out over 100 acres.

The nursery being prepared, the seed on arrival should be immediately sown in the beds, in rows six inches apart and six inches between the rows. A round peg is pushed into the ground to a depth of two inches, and one seed dropped into this hole, flat side downward, the earth pushed back, and so on till all is sown. If the nursery is in a shady situation, nothing further except the daily watering (best after sunset) and weeding will be required. If not in a shady

situation, artificial shade must be provided—best accomplished by covering the beds over with a heavy coating of straw or grass, or by driving forked props into the ground along the sides of the beds, laying saplings along these, and covering the whole with branches or palm leaves. The height of this covering should be sufficient to allow of the weeding by hand being easily attended to. The watering should be done by a watering-can with a very fine rose, or by a hose from a 400-gallon tank raised above the level of the beds and kept full by means of a pump. In this nursery the plants will remain till they attain a height of eight or nine inches, or have developed one pair of primary branches.

Great care must be taken to gradually remove the shade in the nurseries as the seedlings develop. By so doing they are gradually inured to stand the weather when planted out. If young seedlings are so treated and are gradually inured to the full heat of the sun, there is no necessity for any artificial shade, except mulching with grass, when planted out in their permanent positions. In all, from the time the seed is put in the nursery till the seedlings are ready for transplanting, a period of about six months will elapse. As the transplanting should take place at the commencement of the rainy season—say by the beginning of October or November, it is obvious that the nursery should be started about the beginning of April, or earlier.

TRANSPLANTING.—The field to be planted should be thoroughly well ploughed (the deeper the better), harrowed, cross ploughed, and harrowed again, and got ready by the beginning of the rainy season. The lining out of the land should then be done, and this is easily accomplished if the land has been thoroughly cleared of timber, stumps, etc., by running out drills with the plough, parallel to each other and 8 feet or 12 feet apart, accordingly as Arabian or Liberian coffee is the crop. Now run cross furrows parallel to each other and at right angles to the first lot. The intersections of these furrows will be the places for the plants.

Holes are now dug to a depth and width dependent on the size of the seedling plants; or, if the land has not been cleared and the stumps remain, a good stout clothes-line, having bits of cloth tied on at distances of 8 feet apart, may

be stretched across the plot to be planted, and pegs driven in at each mark, to indicate where the holes are to be dug. Eight feet from these pegs the line is again stretched, and so on till the field is all lined out. The system of lining out ensures regularity in the rows. In removing the plants from the nursery, a cloudy, damp day should be selected, and each plant removed with a good sized ball of earth round its roots. If the tap-root is too long it may be severed by an oblique cut with a sharp knife. The seedling should be carefully planted in the hole prepared for it, care being taken to keep the tap-root straight, the earth well pressed down all round, a good double handful of hay or grass laid all round it, and the plant left to take its chance. The object attained by this mulching of hay or grass is not to keep the sun off the plant, but off the *earth round* the plant. If the planting out has been done in wet or showery weather, and the season does not get too dry, the future of the plants need occasion no worry.

AFTER TREATMENT.—The after treatment till the plants come into bearing, which will take place about two and a half to three years from the date of planting, will be the rigorous exclusion of all weeds; a free use of the scarifier or horse-hoe will readily effect this. Should the wind breaks left not be sufficient, it will be found necessary to support each plant by driving a stake into the ground alongside and fastening the stem to it. Again, if shade is absolutely necessary owing to the continued dryness of the weather, it will be advisable to plant maize or sorghum between the rows; it grows quickly, and will provide ample shade, while at the same time a partial return for the outlay is secured.

Drainage must now be attended to. Water must not be allowed to lie about in hollows or inequalities of the ground, which must all be drained to a lower level. If the coffee plot is on the slope of a steep hill, terracing will have to be resorted to prevent the soil being washed away, and perhaps the plants with it; but steep hill sides had better be avoided. During the two years before the plant comes into bearing the energetic planter will endeavor to attain a high degree of cultivation in his coffee plot.

PRUNING.—In addition to the necessary drainage, terracing,

and weeding of the coffee plot during the period before bearing, the plants must also be "handled" to a certain extent. Pruning consists of various operations connected with either arresting the height of the plants to cause them to spread out laterally, or in removing the additional growth of wood to encourage the plants to push out new fruit-bearing shoots. These operations are technically known as topping, handling, and pruning.

TOPPING.—Were the coffee plant left to itself it would grow upwards till it attains a height of twenty feet and over, and were this allowed, it is obvious that the gathering of the fruit would necessitate the use of ladders—an inconvenience, to say the least of it, apart from the damage done to the fruit-bearing branches by rubbing and breakage. It is usual, therefore, when the plants attain a height of from $4\frac{1}{2}$ feet to 5 feet, to nip off the central bud with the finger and thumb, if the wood is soft enough, as it usually is, to allow of this, otherwise a knife is used. This operation is known as topping. The first result of topping is to induce the growth of suckers or shoots under the joints of the primary branches or on the stem. These are rubbed off as soon as noticed, without injury to the bark, as they are then very tender. This operation is called handling.

From the "primary" branches spring "secondary" branches in pairs at short intervals. Any appearing within six inches of the main stem are cut away at once, so as to leave a free passage for the admission of air and some light. The object of pruning is simply to divert the energies of the plant from forming wood and to concentrate them upon forming fruit. The fruit is borne by young wood and as the "secondaries" are reproduced when removed, they are cut off as soon as they have borne, and a constant succession of young wood is thus secured. If the topping and handling above described have been carefully attended to, this operation of pruning will not be found necessary before the third or fourth year from planting. That is to say, two crops will have been got off before pruning becomes necessary, if at all.

The practical effect of pruning is to limit the height of the plant, say, to five feet, and force it to develop, horizontally, "primary" branches at intervals of 6 inches throughout the

entire height, and to form along these branches a constant supply of secondary fruit-bearing twigs. All upward branches, or branches running crosswise, are removed. This treatment forces the bushes to grow out laterally exposing a large surface to the sun and light, and from which the crop can be easily secured. Pruning must be done as soon as possible after the crop has been gathered. It is usual in pruning to leave the opposite lateral to that removed, so as to allow of its fruiting next year. By cutting the "secondaries" thus every other year, a continuous crop is secured. A "primary" must never be cut. Broken, diseased, or dead branches must always be removed.

LIBERIAN COFFEE.—The Liberian variety soon grows up into a tree, running up when not topped to thirty feet, and, being a very deep feeder, is less liable to be injured by dry weather. The Liberian does not come into bearing till four years old, but when it does the yield is much heavier than the Arabian; 1100 pounds and over per acre have been got, and that from 700 trees to the acre. The Liberian need not be pruned—in fact, would be better left unpruned, beyond pulling off the suckers for the first year or two to prevent the tree from running up into too many stems. The cherries of the Liberian variety remain firmly fixed on the tree for many weeks after they are ripe enough to pick—a very important matter when there is a scarcity of labor. Owing to the size of the cherries, the ordinary pulping machinery is not effective. Special pulpers for Liberian coffee are procurable, however, as stated in a previous article, on page 25.

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*EXTRACTS FROM MR. J. W. FORSYTH'S REPORT
ON COFFEE TO THE HAWAIIAN GOVERN-
MENT.*

[The following extracts from the above report, published in 1888, give the views of an experienced coffee grower in regard to the industry in these islands.]

On the Island of Hawaii, District of Hamakua, there are several small sections of land planted with coffee. The plantation of Honokaa, at an elevation of 1,700 feet, has about an acre of coffee planted. The trees are in the neighborhood of twelve years of age. I estimate the crop on them to be

nearly ten hundred weight per acre. This is over and above what has been already picked off this season. Mr. Rickard is of opinion that from three to four pounds of coffee per tree could be gathered yearly.

The trees were in excellent condition, very little shaded, and free from blight, except only in the case of a few isolated trees which were almost completely choked with Hilo grass, and in a sickly and dying condition. Diseases and plagues of all kinds are less apt to attack trees of vigorous health, and free from objective influences. Weakly trees and those exposed in consequence of neglect in the way described, are sensitive to all kinds of pests. Mr. Kinney, formerly manager of Onomea, Hilo, has planted quite a large quantity of coffee in that district. I am informed by him that he has planted out fully 50,000 trees, which are now being uprooted to make way for sugar cane. Elevation about 1,000 feet above sea level. These trees have been planted far too close together, a very common error, and allowed to grow naturally. The effect is patent; at the age of three to four years the branches interlace, a shade is cast on the lower primaries, which become, in consequence, weak, spindly and unproductive. To make matters worse, the coffee trees have been planted under too dense a shade. In fact sunlight and daylight have been more than semi-excluded. Accordingly the tree is drawn up to seek the light, which hampers it as a producer. Coffee never blossoms freely under shade, and without blossom there can be no crop.

Daylight, and all the daylight, is absolutely necessary for coffee. Nowhere in the world are shade trees planted among coffee, except only to protect it from the scorching rays of the sun, and in localities only where there is an insufficient rainfall, *and* where there are long periods of dry weather. Shade, under these conditions, is always *planted*, and that judiciously and with care. Mr. Kinney informs me that from three to four pounds of clean coffee could be reckoned as an average annual return from trees grown under the best auspices, which agrees with all the other accounts that have reached me.

KAU COFFEE VERY FINE.—In Puna I saw very little coffee. In the district of Kau, above Hilea Plantation, there are sev-

eral patches of coffee, by far the best I have seen.—exposed to sunlight and daylight and quite free from blight,—but again too closely planted to return their best results. I should estimate the crop on these patches to be at the rate of twelve to fifteen quintals (100 lbs.) per acre. The soil is very similar to that of Hamakua and Hilo; deep friable loam, chocolate colored, and a subsoil drainage. These trees were totally free from any indications whatever of blight.

COFFEE IN KONA.—In Kona there has been a great deal planted, but nowhere did I see an intelligent effort. No one appears to have had any knowledge of the requirements of the coffee shrub. All attempts are alike. One person appears to have copied the method of his neighbor, without any regard as to whether he was right or wrong.

Throughout the whole of Kona I saw but very little blight; indeed only in the case of isolated trees surrounded and choked with Hilo grass, or overshadowed and touched by the guava tree. Everywhere, removed from these influences, the coffee was as fine as coffee can possibly be. I never saw better conditioned trees than the majority of those in Kona.

Nowhere is coffee machinery employed of any kind. This is very much to be regretted, as a single pulper can do as much and better work than a hundred men, with the primitive methods used. Peeling and sizing machinery too, is quite unknown.

In regard to coffee blight, which I was told would forever prevent coffee being a paying industry, I may say that this experience is not confined alone to these Islands.

BLIGHT IN CEYLON.—The Dimbula district of Ceylon, was at one time, threatened to be exterminated as a coffee country. The plague was so bad that planters contemplated abandoning their estates; but looking forward hopefully to the eternal "next year," for a prospect of a new order of things, their perseverance was rewarded. The trees became acclimatized, and to-day, in fact, for some years past, there has been scarcely a vestige of the pest to be seen. Dimbula, when I left, was the largest sheet of unbroken coffee in the world. My opinion in regard to the coffee at present planted here, is that the trees, as was the case in Dimbula, are acclimatized, or becoming so very fast.

In confirmation of the above statement I beg to quote the following extract from Ferguson's Directory, Ceylon:

"In the early days, black bug or blight affected the coffee plant very seriously. Whole fields were prevented from cropping by this evil, and it was mainly on account of the prevalence of bug that any extension of cultivation to Dimbula and Dickoya was condemned. But who ever hears of blight now? One hundred thousand acres have been planted in the wilderness of the Peak since then, and the area affected by bug there or elsewhere in the Island, has been most trifling. But the place has been more than filled by the most terrible of all diseases, Hemelia Vastatrix, or coffee leaf disease."

Of the terrible effects of this coffee scourge, I need only say that since the year 1869, when it made its first appearance, the coffee crops of Ceylon fell off during the first decade of years, more than one-half of their greatest production.

DANGER OF BRINGING THE DISEASE HERE.—In a letter which I addressed to the President of the Planters' Association, Honolulu, from Honokaa, Hawaii, I urged upon them, at this meeting, the necessity of drawing the attention of the Minister of the Interior to the danger to this country of would-be benefactors, bringing plants of coffee from the East Indies, with a view to change the seed here. I desire to embody a similar warning in this report, so that it may reach every one interested in planting on Hawaii. There may be even now plants on their way for the very purpose suggested. I would strongly advise them being destroyed before landing. The pest was introduced into the Fiji group of Islands in this way, where I saw it and reported upon the matter. It has also extended its ravages to southern India and Java.

These Islands are quite isolated, and it is easy to keep them free from contamination. A great industry undeveloped, has as much right to be protected as those already established. Scientific men shake their heads at the idea of leaf fungus disappearing in the same mysterious way that it began. "It has found its food, and why should it go, so long as there is a coffee tree left for it to live on," fairly represents the opinion of Dr. Thwaites, Dr. Frimen or Marshall Ward. The eminent mycologists have not given the planters much more comfort.

HOW TO PLANT COFFEE.—As I have before stated, the first qualification is rich, deep soil, as coffee is a large producer and calls equally largely from the soil. The amount of return of crops is regulated according to the fertility of the soil; like cinchona, it rejoices more in sloping, and even steep lands, than flat. I would strongly advise caution being observed in selecting *pahoehoe* formation covered with a layer of soil.

To select lands for the cultivation of coffee, a thorough knowledge of all the requirements of the tree is necessary, as a maximum return to a given area is the object to be gained, and where any of these requirements are wanting, coffee had better not be tried.

I know of no reason why cinchona and coffee cannot be grown equally well in the choicest parts of Kona and Puna on the old *a-a* formations, as districts mentioned, but as I have never planted on similar land, cannot say positively.

Like cinchona, coffee is also very sensitive to "wet feet" and any land of a spongy nature that retains water will assuredly kill coffee. *A-a* formation containing a sufficiency of soil is best adapted to the requirements of the coffee shrub, as it takes very kindly to stony or rocky land, if accompanied by a subsoil drainage. The degree of decomposition, however, of the *a-a* must be taken into consideration. The older the flow the better; I do not need to enlarge upon this, as everyone will easily understand my meaning, who has the least knowledge of the formation of this country.

DISTRICT OF PUNA.—The district of Puna is a vexed question to me. I cannot say positively if the decomposition of the *a-a* has far enough advanced to ensure a permanent success to coffee, as beneath the surface, say three or four feet, the *a-a* is not packed with soil, but lies somewhat loose. The trees I saw, however, upon the whole, were very good indeed.

The proper distance apart to plant coffee, must not be less than 9x9 feet, which gives 540 trees to the acre. This distance ensures the light of day to circle round the tree.

Grass lands are universally acknowledged to draw from the soil the food necessary for coffee, and plantations opened on old pastures have always been unsatisfactory. Therefore it will be well to avoid lands which are overrun with Hilo grass. I am of opinion, however, that if Hilo grass has only

recently established itself on virgin lands, the harm cannot be great.

CHOICEST DESCRIPTION OF LAND.—The choicest lands are those which are fern-clad and covered with bush or forest. I would also advise raising nurseries of plants, and not to propagate from seedlings which have grown from seeds dropped off the coffee trees. Plants taken from a dense shade, are always weak, spindly and difficult to raise, whilst those propagated in nurseries possess clusters of roots, and from the very beginning, when planted in the open, will form themselves into well shaped trees.

After lining 9x9, the next work in the order of progression is to prepare the holes for transplanting. These holes should, as in the case of cinchona, be dug beforehand, and can be done in any weather, thus facilitating planting when the proper season begins.

The season for planting is during the rainy weather, and care must be taken not to plant until the ground is well saturated to a considerable depth. Plants put out in semi-dry soil are likely to fail. Coffee, to succeed financially, must be planted in the way described, in proper plantation form, and on a scale large enough to take advantage of machinery for the purpose of pulping and curing.

ACREAGE AND ESTIMATED RETURN—I should advise not planting less than 200 acres. This area will yield about 3,000 quintals (one quintal 100 lbs.) of clean dry coffee, annually, allowing that each coffee tree will yield an average of say three pounds per tree. In making this estimate I take 500 trees per acre, whereas the total amount of trees to the acre planted 9x9 is actually 537. The proposition will stand thus: 500 trees per acre $\times 200 = 100,000$, the number of trees planted on 200 acres. $100,000 \times 3 = 300,000$, the number of pounds annually returned.

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COFFEE PLANTING IN HAWAII.

(FROM A PAMPHLET ISSUED IN HONOLULU, 1888.)

Mr. W. J. Forsyth, a gentleman who has had large experience in the coffee business in Ceylon and Central America, and was employed by the Hawaiian Government for six months to visit various parts of the Islands with a view to

observe and examine localities, soil, and climate, and to report upon the suitability of lands for the cultivation of Cinchona and Coffee made a report, which was published in the January number of the *Planters' Monthly*, of 1888.

As a result of his observations and the information he obtained, he was thoroughly persuaded that if the cultivation of Coffee is entered into in certain localities here, in an intelligent manner, following largely the methods, and using the machinery and appliances adopted in countries where coffee is most successfully produced, that in a few years coffee will become one of the important articles of export from these Islands, and a source of profit to those who engage in it.

It is well known that these Islands have for many years produced coffee of the finest quality, but the business has been conducted in an unsystematic and irregular manner and by men of little or no experience in the business, and with none of the modern machinery and appliances for curing.

THE PLANTATION.—A plantation established in some favorable locality, and capable of planting 200 acres, will carry 100,000 trees, 500 trees to the acre being a fair average. After the fourth year an average annual yield of about 3 lbs. per tree may be expected. At 15 cents per pound the annual crop would return \$45,000.

Healthy trees will continue bearing for thirty years, and if in good soil and properly cultivated and pruned, the yield will continue with much uniformity during the whole period.

The heaviest expense will be incurred before the first crop is harvested. Land must be procured, cleared, fenced, and planted; and the trees cultivated and pruned for four years. Houses for the manager, workmen, and the mill must be built; machinery imported and erected.

The total cost, from the starting of the enterprise, until the first crop is harvested and ready for market, is estimated at about \$68,000. After the fourth year, the annual expenses should be about \$25,000, and the average yield about as before stated.

OBSTACLES TO BE MET.—Upon a thorough and careful personal examination of many localities on these Islands where

coffee is growing, and from all the information that he has been able to obtain after diligent and searching investigation, Mr. Forsyth is satisfied that there are no obstacles in the way of successful growing and curing coffee in many portions of these Islands, which cannot be wholly overcome.

The great bug-bear, which has for years deterred the investment of capital in coffee culture in this country, has been fear of blight.

The history of blight in Ceylon is, that after an existence of some ten or fifteen years, doing great damage, it gradually disappeared, and now the blight is troublesome only upon neglected estates, or in localities where the soil is poor, and is hardly counted as a factor in the production of coffee.

The experience in these Islands is similar. About 1857-8 the coffee industry had an apparently bright future. A number of plantations were started, principally in Hanalei, Kauai, and in Kona, Hawaii, when the blight suddenly appeared, and in a very short time the production had almost ceased. The blight continued in unabated force for some fifteen years. Since that time a diminution of its prevalence has been steadily going on, until now a blighted coffee tree is the exception and not the rule.

Another cause of blight, which experience in other countries has demonstrated, is that coffee planted near sea level, say less than 1000 feet above sea level, is much more subject to its ravages than at a greater elevation. The coffee plantations started at Hanalei, above referred to, were on the flats in the valley, only a few feet above sea level, and much of the Kona coffee was and is near the coast. Coffee now growing on the mountain, back of Kahuku on Oahu; at an elevation of about 1000 feet; also at Makawao, Maui, at an elevation of about 1800 feet; at Mr. J. M. Horner's at Hamakua, Hawaii, at an elevation of about 1300 feet; at Mr. W. H. Rickard's in the same district at an elevation of 1700 feet; at Onomea, Hawaii, at an elevation of 1100 feet, and many trees in Kona, Hawaii, at an elevation of less than 1000 feet, are almost entirely free from blight.

At the residence of Dr. Smith, in Koloa, Kauai, at an elevation of not more than 200 feet, coffee has been growing luxuriantly, bearing heavy crops, for a numbers of years, and showing no sign of blight.

Experience both here and in other countries indicates that blight need no longer be counted as one of the serious obstacles to success in coffee culture.

WAGES AND EXPENSES IN GUATAMALA.—Another point which has been considered fatal to profitable coffee culture, is the high rate of wages ruling here, while we must compete with countries where the price of labor is much less.

The difference is, to a great extent, more apparent than real. For example, in Guatamala, wages rule from 25 to 37 cents per day. In the first place the laborers are Indians, not habituated to steady labor, and therefore do not accomplish as much work in a day as an ordinary workman.

Again: There is no system of controlling the laborers, and engagements to labor cannot be enforced. The Indian will not do any work unless he is paid in advance, from one half to three quarters of the amount which his wages will come to for the crop.

Other difficulties which the Guatamala Coffee planter has to contend with, are totally lacking here, and these alone are amply sufficient to offset the actual difference in the price of labor.

For example, the roads from the interior are simply trails, and most transportation has to be upon mule back; the average cost of this transportation is about \$2.00 per hundred pounds. A Government monopoly rail road to the landing charges 60 cents per hundred pounds. A Government monopoly wharf and warehouse charges 30 cents per hundred pounds; lighterage from the wharf to the steamer is 32 cents per 100 pounds; export tax is 25 cents per 100 pounds; making a total cost of \$3.47 or \$69.40 per ton, for getting the coffee from the plantation on board of the vessel. This cost will be so low here that it may be called simply nominal.

In spite of all these drawbacks, coffee culture is steadily increasing in Guatamala, is profitable to the planter, and is now the largest item of export, having amounted in 1886 to 50,000,000 pounds.

With the superior labor obtainable here; the absence of Government monopoly taxes; the employment of the best labor-saving machinery, and the large yield which the coffee tree produces, Hawaii, to day, offers a most promising field for profitable investment of capital in coffee culture.

APPROXIMATE ESTIMATE OF ESTABLISHING A COFFEE PLANTATION OF 200
ACRES IN EXTENT, AND CARRYING ON CULTIVATION FOR FIVE
YEARS; TOGETHER WITH COST OF PURCHASE OF ADDITION-
AL 300 ACRES.

OUTLAY FIRST THREE YEARS.

Purchase of 500 acres of land, at \$10.....	\$ 5,000 00
Clearing " 200 " " " \$25.....	5,000 00
Manager's Cottage and accommodation for overseer and 50 laborers.....	2,200 00
Temporary Iron Roof for catching water.....	150 00
Nursery for 120,000 plants, @ \$8 per 1,000, cost of raising.....	960 00
Holeing, 1 man to hole 60 holes per day, 18x18 square inches, wages \$1.....	1,660 00
Planting, 1 man 100 plants per day.....	1,000 00
Transport of plants to field.....	200 00
Purchase of tools.....	200 00
20 Iron Tanks for water reservoir.....	500 00
Erecting above and cost of transport.....	200 00
Two Coffee Pulpers, steam.....	500 00
Two do do hand.....	300 00
Four Cisterns of stone properly cemented.....	300 00
Lining.....	200 00
Receiving Cisterns in field for measuring coffee, say four 8x8x2 wood.....	200 00
Washing Machine.....	250 00
Coir Matting say.....	500 00
Formation of Barbeque.....	400 00
Two Smoot's Peelers for peeling parchment and silver skin off coffee.....	2,000 00
Coffee Sizers.....	200 00
Air Blast and Elevators.....	150 00
Boiler & Engine 10 H Power.....	1,700 00
Buildings for Mill and Store.....	4,000 00
Cost of erecting Machinery, Engineer or Mechanic and 4 laborers for say 5 months.....	1,500 00
Two miles of coffee spouting rolled and laid down for use, allowing \$60.00 to every 300 feet.....	2,100 00
Shafting, belting, wheels & pulley estimated at.....	500 00
Extra Mason labor.....	300 00
Labor: Topping Coffee trees.....	100 00
Handling or hand pruning 50 acres of coffee 4 times in the year, for 3 years at the rate of 500 trees per man.....	600 00
Pruning 50 acres.....	200 00
Expense of up-keep or cleaning coffee estate for 3 years, cleaning every 3 months at \$1.50 per acre for each cleaning.....	3,600 00
Purchase of 2 Horses or Mules.....	200 00
Salary of Manager for 3 years at the rate of \$200 per month.....	7,200 00
Salary of Field overseer for same period @ \$600.....	1,800 00
Transport of Material from landing to Mill site say.....	1,000 00
Purchase of coffee seed and planting of shade trees.....	600 00

FOURTH YEAR.

Picking maiden crop say 2 lb per tree, together with all other charges of curing 6 cts. pr lb.....	12,000 00
Purchase of Coffee Bags.....	210 00
Cleaning, Pruning, & Handling.....	2,000 00
Salary of Manager and Overseer.....	3,000 00
Sundries.....	1,000 00

FIFTH YEAR.

Picking and curing a crop of 3,000 centals or say 300,000 lbs. @ 6 cts.....	18,000 00
Salaries Manager & Overseer.....	3,200 00
Cleaning, Pruning, Handling.....	2,000 00
Sundries.....	1,000 00
Purchase of Bags.....	315 00

Total.....\$89,995 00

ANALYSIS OF THE FOREGOING.

FIRST YEAR.

Purchase of Land, say	5,000 00	
Clearing, Holeing & Lining	6,860 00	
Nursery & Purchase of seed	1,160 00	
Salaries of Manager & Overseer	3,000 00	
Purchase of Tools, &c.	200 00	
Houses, Manager and Laborers	2,200 00	
Planting	600 00	
		19,020 00

SECOND YEAR.

Planting, Handling and Pruning Coffee tree, cleaning and up-keep of Estate, and Salaries	6,700 00
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THIRD YEAR.

Cost of Mill, purchase of Machinery, planting and all charges in perfecting plants, including Salaries	21,855 00
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FOURTH YEAR.

Cost of picking and caring 200,000 pounds of Coffee at 6 cents per lb.	12,000 00	
Salaries, Upkeep, Pruning, Handling	6,210 00	
		18,210 00

FIFTH YEAR.

Cost of picking and securing 300,000 pounds	18,000 00	
Salaries and up-keep of estate	6,210 00	
		24,210 00
Total		89,995 00

APPROXIMATE RETURNS.

By Sale of the first crop of coffee in the 4th year dating from time when coffee seed was first sown in Nursery, Product of Maiden Crop, say 200,000 lb @ 15 cts.	30,000 00
Product of second Crop, (5th year,) say 300,000 lbs., at 15 cents.	45,000 00
Total	\$75,000 00

N. B.—The Mill will have capacity to work a crop of 600,000 to 800,000 pounds per annum, and can be increased with but small additional cost; so that the whole of the Coffee Cherry grown in South Kona (if that district were selected) could be cured at the Mill.

A VALUABLE TABLE.

Number of trees contained in an acre, planted as follows:

9 ft. × 9 ft. =	537 trees per acre.
8 " × 8 " =	680 " " "
7 " × 8 " =	888 " " "
6 " × 7 " =	1037 " " "
6 " × 6 " =	1210 " " "
6 " × 5 " =	1452 " " "
5 " × 4 " =	1742 " " "

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